WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: PA2881

Title: In-line Coagulation for Microfiltration

Focus Categories: Treatment, Waste Water

Keywords: Pollution Control, Water Treatment, Water Reuse, Water Quality, Membranes

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Non-Federal Matching Funds: $26,489

Congressional District: 5th

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Abstract

This project addresses the in-line use of coagulants for micron filtration of water for potable use and of wastewaters for beneficial re-use. The objectives are to determine the characteristics of coagulated solids that result in low trans-membrane pressures (TMP), long operation between chemical in-place cleaning (CIP), and removal of "filterable" contaminants.

Micron filtration is an increasingly popular technology for treatment of potable water and of wastewater. However, strategies for in-line coagulation / micron filtration have not been established. It is hypothesized that micron filtration will be effective for contaminant/coagulant conditions that do not work for conventional depth filtration applications. This could allow enhanced removal of dissolved constituents that would not be removed by micron filtration in the absence of coagulant. This project will deal with theoretical and applied aspects of coagulation / micron filtration.

Limited pilot-scale experience with in-line micron filtration (ILMF) has demonstrated that low doses of coagulant can increase times between CIP and minimize TMP whereas higher doses result in poor performance for both CIP and TMP. ILMF using poly-aluminum coagulants has proven more effective than alum. Work by the PI shows that floc with zeta-potential (ZP) close to zero forms a porous cake that initially provides high permeate flux, but the flux decreased after application of a hydraulic shear. Floc with high ZP (either negative or positive) gave lower initial permeate fluxes in laboratory filtration units, but higher flux was obtained by application of hydraulic shear.

Two coagulation regimes that are inappropriate for conventional processes will be compared to the conventional coagulation regimes (charge-neutralization and sweep floc). The first test regime will be low pH, charge re-stabilized floc that would be very effective for enhanced removal of DBPP's and arsenic. The second test regime will be alkaline pH, coagulant under-dosed which could be appropriate for "Great Lakes" quality waters.

This research will involve bench-scale testing at Penn State, and field application of the results for potable water and wastewater. Major independent variables for both bench-scale and pilot-scale testing will include

organic carbon concentration, coagulant type, coagulant dose, pH, zeta-potential of resulting solids, and MF operating conditions. Dependent variables will include TMP, CIP frequency and effect, yield, and finished water quality.